Aphasia

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Abstract

Aphasia is a disturbance of the use of language due to disease of the brain. Early approaches to describing aphasia emphasized patients' abilities to speak, understand spoken language, and read and write, and paid little attention to the elements of language that were affected in these tasks or how they were affected. These theories have provided a basis for classifying aphasias and for relating some aspects of language to the brain that is still in clinical use. Modern approaches to aphasia try to delve deeper into the nature of aphasic impairments, by saying what parts of language are affected (e.g., problems with comprehension of sentences could be due to problems affecting word recognition, not knowing what words mean, or not being able to relate words to one another in a sentence), and how they are affected. This article presents an overview of aphasia, beginning with the traditional clinical descriptions and ending with more modern approaches.

Aphasias are disturbances of language following diseases of the brain. Clinical approaches to describing aphasias evolved from nineteenth-century descriptions that emphasized the language task that was affected – speaking, understanding spoken language, reading, and/or writing – and a limited description of the linguistic impairments in patients, such as whether a disturbance of speech affected grammatical forms or content words. This approach was related to a model of where the processing of speaking, understanding spoken language, reading, and writing simple words was located in the brain, and has given rise to a set of aphasic syndromes that are widely recognized by clinicians today. Modern descriptions of aphasic patients have taken major steps toward capturing the details of the linguistic impairments in patients. This research has led to better understanding of how language processing is organized and how it breaks down. However, the goal of understanding the relation between language processing operations and brain structures remains to be achieved.

Definition

The term 'aphasia' refers to disorders of language following diseases of the brain. As is discussed in other articles in this encyclopedia, language can be conceived of as a distinctly human symbol system that relates a number of different types of forms (words, words formed from other words, sentences, discourse, etc.) to various aspects of meaning (objects, properties of objects, actions, events, causes of events, temporal order of events, etc.). The forms of language and their associated meanings are activated in the processes of speaking, understanding speech, reading, and writing. The processes whereby these forms are activated are largely unconscious, obligatory once initiated, fast, and usually quite accurate. Disturbances of the forms of the language code and their connections to their associated meanings, and of the processes that activate these representations in these ordinary tasks of language use, constitute aphasic disturbances. By convention, the term 'aphasia' does not refer to disturbances that affect the functions to which language processing is put. Lying (even transparent, ineffectual lying) is not considered a form of aphasia, nor is the garrulousness of old age or the incoherence of schizophrenia.

Language consists of a complicated system of representations, and its processing is equally complicated, as described in other articles in this encyclopedia. Just the representation of the minimal linguistically relevant elements of sound – phonemes – and the processing involved in recognizing and producing these units constitute a highly complex domain of functioning. When all the levels of language and their interactions are considered, language processing is seen to be enormously complex. Aphasic disturbances would therefore be expected to be equally complex. Researchers are slowly describing the very considerable range of these disorders.

History of the Field: The Classic Aphasic Syndromes, and Alternative Views

The first modern scientific descriptions of aphasia were quite modest with respect to the descriptions of language processing that they contained. These descriptions were made by neurologists in the second half of the nineteenth century. Though modest with respect to the sophistication of the descriptions of language, these studies laid important foundations for the scope of work on aphasia and for the neural basis for language processing, which has always been a closely associated topic. The first of these late nineteenth-century descriptions was that by Broca (1861), who described a patient, Leborgne, with a severe speech output disturbance. Leborgne's speech was limited to the monosyllable 'tan.' Broca described Leborgne's ability to understand spoken language and to express himself through gestures and facial expressions, as well as his understanding of nonverbal communication, as being normal. Broca claimed that Leborgne had lost 'the faculty of articulate speech.' Leborgne's brain contained a lesion whose center was in the posterior portion of the inferior frontal convolution of the left hemisphere, an area of advanced cortex just adjacent to the motor cortex. Broca related the most severe part of the lesion to the expressive language impairment. This area became known as 'Broca's area.' Broca argued that it was the neural site of the mechanism involved in speech production.

In a second very influential paper, Wernicke (1874) described a patient with a speech disturbance that was very different from that seen in Leborgne. Wernicke's patient was fluent; however, her speech contained words with sound errors, other errors of word forms, and words that were semantically inappropriate. Also unlike Leborgne, Wernicke's patient did not understand spoken language. Wernicke related the two impairments – the one of speech production and the one of comprehension – by arguing that the patient had sustained damage to 'the storehouse of auditory word forms.' The lesion in Wernicke's case was unknown, but a lesion in a similar case was the area of the brain next to the primary auditory receptive area, which came to be known as Wernicke's area.

These pioneering descriptions of aphasic patients set the tone for much subsequent work. First, they focused the field on impairments of the usual uses of language – speech, later on reading and writing. This seems like an obvious area for aphasiology to be concerned with, but not all researchers of the period agreed with this focus. In another famous paper, the influential British neurologist John Hughlings Jackson (1878) described a patient, a carpenter, who was mute but mustered up the capacity to say 'Master's' in response to his son's question about where his tools were. Jackson's poignant comments convey his emphasis on the conditions that provoke speech, rather than on the form of the speech itself:

> The father had left work; would never return to it; was away from home; his son was on a visit, and the question was directly put to the patient. Anyone who saw the abject poverty the poor man's family lived in would admit that these tools were of immense value to them. Hence we have to consider as regards this and other occasional utterances the strength of the accompanying emotional state.
> Jackson, 1878, p. 181

Jackson sought a description of language use as a function of motivational and intellectual states, and tried to describe aphasic disturbances of language in relationship to the factors that drive language production and make for depth of comprehension. Broca, Wernicke, and the researchers who followed focused aphasiology on patients' everyday language use under what were thought to be normal emotional and motivational circumstances.

These and related subsequent papers tended to describe language impairments in terms of the entirety of language-related tasks – speaking, comprehending, etc. – with only passing regard for the details of the language forms that were impaired within a task. A patient's deficit was typically described in terms of whether such an entire function was normal or not, and whether one such function was more impaired than another was. Here, for instance, is the description of Broca's aphasia by two twentieth-century neurologists whose work follows in this tradition:

> The language output of Broca's aphasia can be described as non-fluent … Comprehension of spoken language is much better than speech but varies, being completely normal in some cases and moderately disturbed in others.
> Benson and Geschwind, 1971, p. 7

The one level of language that descriptions did tend to concentrate on was the level of words. For instance, in the same passage, Benson and Geschwind point out that patients with Broca's aphasia often omit function words (e.g., determiners such as 'the') and word endings, but produce at least some nouns. Altogether, the clinical approach to aphasia, derived most directly from early work, emphasized the usual tasks of language use and just began to describe impairments in linguistic and psycholinguistic terms. This approach to aphasia led to the recognition of 10 classical aphasic 'syndromes.' These are listed, along with their proposed neural bases, in **Table 1**.

Psycholinguistic Approaches to Aphasia

As noted in the previous section, the classical aphasic syndromes do not give a complete account of the range and specificity of aphasic impairments. More recent descriptions of aphasia add many details to the linguistic and psycholinguistic descriptions of these disorders. It is impossible to review all these impairments in the space of a short article, but a few examples will illustrate these results. For instance, at the first step of speech processing – converting the sound waveform into linguistically relevant units of sound – researchers have described specific disturbances affecting the ability to recognize subsets of phonemes such as vowels, consonants, stop consonants, fricatives, nasals, etc. (Saffran et al., 1976). In the area of word production, patients have been described with selective impairments of the ability to produce the words for items in particular semantic categories, such as fruits and vegetables, but sparing animals and man-made tools (Hart et al., 1985); selective impairments affecting the ability to produce nouns and verbs (Damasio and Tranel, 1993); and other highly restricted deficits. In the area of reading, patients have been found to have impairments of the ability to sound out novel written stimuli using letter–sound correspondences but retained abilities to read familiar words, and vice versa (Marshall et al., 1980; Patterson et al., 1985).

Linguistic theory provides a basis for exploring the nature of aphasic disorders by providing evidence for different types of linguistic representations. Models of the psychological processes involved in activating linguistic representations suggest other possible loci of impairment. Many researchers have worked backward from clinically observed phenomena, developing or modifying theories of language structure and processing on the basis of the disorders seen in aphasic patients. For instance, the finding of patients with disorders of the ability to sound out novel written stimuli but retained abilities to read familiar words and vice versa has led to a model of reading in which there are two ways of pronouncing a written word – sounding it out and recognizing it as a whole. This model is controversial, and some of the strongest evidence for it remains the performance of aphasic patients (Coltheart et al., 2001). Characterizing aphasic disorders is an interactive, interdisciplinary, bootstrapping process that is presently in active evolution.

The psycholinguistic approach to aphasia is based upon a model of language structure and processing. Experts disagree about these models. Some of the greatest disagreements center on the issue of the extent to which linguistic representations are

Table 1 Classical aphasic syndromes

Syndrome	*Clinical manifestations*	*Postulated deficit*	*Classical lesion location*
Broca's aphasia	Major disturbance in speech production with sparse, halting speech, often misarticulated, frequently missing function words, and bound morphemes	Disturbances in the speech planning and production mechanisms	Posterior aspects of the third frontal convolution (Broca's area)
Wernicke's aphasia	Major disturbance in auditory comprehension; fluent speech with disturbances of the sounds and structures of words (phonemic, morphological, and semantic paraphasias)	Disturbances of the permanent representations of the sound structures of words	Posterior half of the first temporal gyrus and possibly adjacent cortex (Wernicke's area)
Pure motor speech disorder	Disturbance of articulation, apraxia of speech, dysarthria, anarthria, aphemia	Disturbance of articulatory mechanisms	Outflow tracts from motor cortex
Pure word deafness	Disturbance of spoken word comprehension	Failure to access spoken words	Input tracts from auditory system to Wernicke's area
Transcortical motor aphasia	Disturbance of spontaneous speech similar to Broca's aphasia with relatively preserved repetition	Disconnection between conceptual representations of words and sentences and the motor speech production system	White matter tracts deep to Broca's area connecting it to parietal lobe
Transcortical sensory aphasia	Disturbance in single word comprehension with relatively intact repetition	Disturbance in activation of word meanings despite normal recognition of auditorily presented words	White matter tracts connecting parietal lobe to temporal lobe or portions of inferior parietal lobe
Conduction aphasia	Disturbance of repetition and spontaneous speech (phonemic paraphasias)	Disconnection between the sound patterns of words and the speech production mechanism	Lesion in the arcuate fasciculus and/or corticocortical connections between Wernicke's and Broca's areas
Anomic aphasia	Disturbance in the production of single words, most marked for common nouns with variable comprehension problems	Disturbances of concepts and/or the sound patterns of words	Inferior parietal lobe or connections between parietal lobe and temporal lobe; can follow many lesions
Global aphasia	Major disturbance in all language functions	Disruption of all language processing components	Large portion of the perisylvian association cortex
Isolation of the language zone	Disturbance of both spontaneous speech (similar to Broca's aphasia) and comprehension, with some preservation of repetition	Disconnection between concepts and both representations of word sounds and the speech production mechanism	Cortex just outside the perisylvian association cortex

highly abstract structures that are produced and computed in comprehension tasks by rules (Chomsky, 1995), as opposed to far less abstract representations that are processed largely by highly developed pattern associations (Rumelhart and McClelland, 1986). If language is seen in the former perspective, many aphasic impairments are considered to be the result of damage to specific representations and/or processing operations. If language is seen in the latter perspective, aphasic disturbances are largely conceptualized as resulting from reductions in the power of the associative system, due to loss of units, increases in noise, etc. Empirical study suggests that both specific impairments and loss of processing power are sources of aphasic disturbances. This can be illustrated in one area – disorders affecting syntactic processing in sentence comprehension.

Disorders of syntactically based comprehension affect the ability to extract the relationships between the meanings of words in a sentence that are determined by the syntactic structure of a sentence. For instance, in the sentence 'The dog that scratched the cat killed the mouse,' there is a sequence of words – the cat killed the mouse – which, in isolation, would mean that the cat killed the mouse. However, this is not what the sentence means, because of its syntactic structure. 'The cat' is the object of the verb 'scratched'; 'the dog' is the subject of the verb 'killed' and is the agent of that verb. Caplan and his colleagues have explored the nature of these disturbances (Caplan et al., 1985, 1996). They found that, in many hundred of aphasic patients, mean group performance deteriorated on sentences that were more syntactically complex and that more impaired groups of patients increasingly performed more poorly on sentences that were harder for the group overall. These patterns suggest that the availability of a processing resource that is used in syntactic comprehension is reduced to varying degrees in different patients. A second finding in their studies has been that individual patients can have selective impairments of syntactic comprehension, just as is the case in the other areas of language processing previously mentioned. Published cases have had difficulty constructing hierarchical syntactic structures, disturbances affecting reflexives or pronouns but not both, and other more subtle impairments of syntactic processing (Caplan and Hildebrandt, 1988).

Overall, these studies suggest that a patient's aphasic impairment can be described in terms of a reduction in the processing resources needed for this function and disruption to specific operations. An unresolved question is whether the entire pattern of performance seen in these disorders can be attributed to just one of these types of impairments, as the two types of models previously outlined maintain. This may be possible, but the challenges in explaining all these aspects of these (and other) aphasic disorders within a model that

either does not incorporate the idea of a processing resource limitation or does not recognize specific operations are considerable.

Functional Consequences of Aphasic Impairments

The focus of this article has thus far been on aphasic disturbances as impairments of the largely unconscious processes that activate the elements of language in the usual tasks of language use. The functional consequences of these disorders deserve a brief comment. Functional communication involving the language code occurs when people use language to accomplish specific goals – to inform others, to ask for information, to get things done, etc. There is no simple, one-to-one relationship between impairments of elements of the language code or of psycholinguistic processors, on the one hand, and between abnormalities in performing language-related tasks and accomplishing the goals of language use, on the other. Patients adapt to their language impairments in many ways, and some of these adaptations are remarkably effective at maintaining at least some aspects of functional communication. Conversely, patients with intact language processing mechanisms may fail to communicate effectively. Nevertheless, most patients who have disturbances of elements of the language code or psycholinguistic processors experience limitations in their functional communicative abilities. In general, as the intentions and motivations of the language user become more complex, functional communication is more and more affected by disturbances of the language code and its processors. Thus, though 'high-level' language-impaired patients may be able to function well in many settings, their language impairments can cause functional limitations that affect family and professional life.

This article should not end on this negative note. Rather, it is important to appreciate that many aphasic patients make excellent recoveries, for a variety of reasons. The natural history of many aphasic impairments is for considerable improvement, especially those due to smaller or subcortical lesions. Though still in their infancy, modern approaches to rehabilitation for aphasia are developing a sounder scientific basis. Technological advances allow for more professionally guided home training using computers, improved augmentative communication devices, and other useful support mechanisms. Support groups for patients and their families and friends are increasing in number; these help patients adjust to the changes in their lives and remain socially active. Though aphasia deprives a person of an important function to a greater or lesser degree, reactions to aphasia are as important as the aphasia itself in determining functional outcome and many aphasic patients function in vital ways after their loss. Lecours et al. (1983) cite a patient described by the Soviet psychologist A. R. Luria, who continued to compose music after a stroke that left him very aphasic; some critics thought his work improved after his illness. Time, rehabilitation, support, and a positive attitude can allow many aphasic patients to be productive and happy.

See also: Speech Production, Neural Basis of; Speech Production, Psychology of.

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